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Pest Control and Pesticides

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Fly the Flag!

EXPORTS OF INSECTICIDES, fungicides and rodenticides from Britain show a disconcerting downward trend for the first nine months of the current year: 213,793 cwts. of a total value of £2,901,017. Estimated to 31st December, at the rate which has prevailed for the period to 30th September this year the figure is around 285,000 cwts. which compares with exports for last year of 345,000 cwts. 354,673 for 1956, and of 476,744 in 1955. For the years 1953 and 1954 the figures in cwts. were 304,948 and 353,906, respectively. It will be seen, therefore, that there has been a steady decline since the peak year of 1955, but the estimated decline as a percentage for 1958 is a high one bearing in mind the reduced overall total.

Prices have not followed the same pattern. For example, in 1957, although the total fell slightly, the value of the exports increased. For the current year the decline in income from exports has corresponded closely with the decline in total quantity of the products under review.

Regarding weedkillers, the trend has not been the same as with insecticides and rodenticides. In cwts. the totals have increased steadily from 38,229 in 1953, to 77,857 a year later, 80,802 in 1955, 85,852 in 1956 and 87,637 last year. But prices fell slightly for 1957 despite the increase in quantity exported.

For 1958, the estimated total based on the average for the first nine months to 30th September, is 62,636, a somewhat startling fall from 1957.

Whether the decline will continue into 1959 is a matter for conjecture. One hopes the downward trend will be arrested and that we may see at least a levelling off in exports. Nevertheless it is of no little significance that the recent annual general meeting of the Association of British Chemical Manufacturers revealed an intention to develop the public relations' activity of the Association.

We welcome this development which we trust will be directed to overseas as well as home trade interests. Speaking with the voice of experience here, we can say quite categorically that a good public relations' service is a boon at any time and for an organisation such as the A.B.C.M. one would think, a necessity.

Criticism in the past has been forthcoming that the Government has not done enough to boost Britain and British industry: so far as pesticides are concerned, let us carry the flag of propaganda into the countries of the world and by whatever legitimate means are to hand.

We ourselves, by circulating to 21 overseas' countries are endeavouring to play our part in what is tantamount to a modern crusade in this battle of letting people overseas know what British manufacturers are producing in this field.

Control of Health Hazards associated with the Use of Pesticides

DISCUSSING THIS SUBJECT in Volume 1 of "Advances in Pest Control Research," Dr. J. M. Barnes observes that in general it can be said the position has changed little since 1952. There is no doubt that those who are in close contact with certain pesticides during their manufacture or application run real risks of poisoning. On the other hand, at the present time there is no evidence to suggest that the general population who may benefit considerably from the use of these materials, is adversely affected by the toxic properties possessed by the pesticides.

"The use of pesticides is likely to continue and to increase. Despite food surpluses in a few areas of the world, pesticides will continue to be used and to increase yields, improve quality and facilitate storage. In public health they will be introduced to control other diseases, when the major causes of death such as malaria have been reduced or eradicated. Diseases hitherto considered to be of lesser importance will then assume a new significance. Finally the reaction of the insects themselves to this attack by chemicals is such as to pose fresh challenges to the synthetic chemist on the one hand and the practical antomologist on the other. The resistance of insects to insecticides has been recognised by the World Health Organisation as one of the most serious challenges which faces it. New chemicals or new uses for the more toxic materials may all find a place in meeting this challenge which is, to some extent, a race against time," Dr. Barnes writes.

During the past several years there have not been a great many new insecticides introduced into widespread use, it is noted. Some of those in use today must almost approach the limits of effectiveness from the point of view of their inherent toxicity to insects. There has been a welcome trend towards the development and introduction of organo-phosphorus insecticides less toxic to mammals. On the whole, however, the health hazard associated with the use of most modern pesticides is not great enough to provide an urgent stimulus to the production of materials safe to handle. It seems reasonable to predict that there may be a slow turnover of pesticides in common use over the next 10-20 years, with the development of some which may be extremely effective for limited purposes. There seems to be a need for efficient nontoxic fungicides and developments in the field of antibiotics for this purpose might be expected here.

"This trend of gradual change," Dr. Barnes goes on, "may disturb those who fear for the public health on the grounds of an exposure to an ever increasing number of chemical substances. On the other hand, the constant changing of the nature of the chemicals to which the population is exposed, does reduce such risks as may be dependent on a lifetime's exposure to small doses of any particular material.

Dr. Barnes recognises that it is impossible to collect reliable data to show whether the general incidence of true poisoning by pesticides is going up or down. While there seems good evidence that the use of pesticides is increasing steadily all over the world, a survey of the medical literature in the major European languages provides no evidence of a corresponding increase in the reports of poisoning either real or suspected.

But in spite of a general awareness of the real and potential hazards arising from the use of pesticides there persists this under-lying fear in many quarters that some danger exists. This fear, like many others, is occasioned to some extent by ignorance. While there is little that can be done to dispel ignorance among those who do not want to find out, there is still much more to be discovered about the toxic properties of pesticides before it will be possible to give a really informed opinion of likely hazards that may arise from any sort of exposure to them.

But the importance of "proper reassurances about the harmlessness of pesticides, or any other new chemical with which human contact is widespread, must be based on a proper examination of exposed populations," is emphasised.

"The work itself is likely to be dull and scientifically unrewarding. It may well be expensive and difficult to organise and carry through. On whom does the responsibility for such an investigation rest? It almost certainly falls on the public health authorities at either a national or international level. Such detailed investigations may be undertaken one day under national or international sponsorship, but meanwhile it seems

reasonable to assume that in a world already made aware of a potential risk to health, no very obvious manifestations of pesticide toxicity are likely to escape notice for long. The use of pesticides continues to bring much benefit to the human race, and in the absence of positive indications to the contrary their use is likely to continue to be officially encouraged. At the same time articles continue to appear which carry the necessary warnings and appeals for care in handling and using these materials."

Toxic Properties of Pesticides

Referring to the toxic properties of pesticides, Dr. Barnes gives a table listing some LD data for rats of some of the new insecticides. He observes that this may be compared with the figures of 2 and 10 mg.-kg. approximately for the LD of TEPP and parathion.

TABLE

The approximate LD for Rats of a Single Oral Dose of some recently developed Organophosphorus Insecticides.

Compound	LD mg.-kg.
O,O-Diethyl *O*-(2 isopropyl-4-methylpyrimidyl-6) phosphorothionate (diazinon)	100-150
O,O-Dimethyl 1-hydroxy-2-trichloroethyl phosphonate (Dipterex)	450
O,O-Dimethyl *O*-3-chloro-4-nitrophenyl phosphorothionate (Chlorthion)	625 1500
O,O-Dimethyl *S*-(1,2-dicarboethoxyethyl) phosphorodithioate (malathion)	1400
Tetra propyl dithionopyrophosphate	1450

If it be assumed that the basic mechanism by which these compounds kill insects and mammals is the same, how is it possible that a compound can still be effective as an insecticide although it is several hundred times less toxic to mammals than related insecticides? asks Dr. Barnes. Several considerations enter the picture and they are rarely discussed in the toxicity reports of these new compounds, he notes.

" If it is assumed that the toxic action of the organophosphorus compounds is based on their capacity to inhibit cholinesterase, then this in turn, depends on a number of factors. The more stable a compound the less effective it is as an inhibitor of cholinesterase. The P=S compounds are very poor inhibitors and must first be oxidised to the P=O analogue. Very little is known about the metabolic processes responsible for this change. It takes place in the liver of mammals, but the process may differ in the insect. Inhibition of cholinesterase is not irreversible and the speed with which activity returns depends upon the nature of the alkyl groups which are attached to the phosphorus atom of the inhibitor. Where these are methoxy, reversal is rapid in the early stages, but if inhibition is allowed to persist by the continued presence of the inhibitor it may pass into a very irreversible stage. Inhibition by ethoxy phosphates is always more slowly reversible but it takes much longer to pass into the truly irreversible stage. Isopropoxy compounds produce an initial inhibition that is slowly reversible which rapidly passes into an irreversible state. However, not only does speed of reactivation depend upon the character of the inhibitior it also depends on the character of the enzyme. Finally the capacity of the organophosphorus compound to act as an inhibitor at all depends upon its remaining intact until it reaches cholinesterase. The presence in the insect or mammalian tissues of enzymes able to hydrolyze the inhibitor without themselves being inhibited might significantly reduce the toxicity of any particular compound. The toxicity of a new organophosphorus compound will therefore depend on a number of factors each of which may play a relatively different role in insect and mammal and so determine whether the ratio of its toxicity toward the one and the other is high or low. Such factors are: (a) the conversion of the original insecticide material to an active inhibitor of cholinesterase, usually by oxidation; (b) the relative affinity of the compound for the different cholinesterases, hence its activity as an inhibitor; (c) the speed of reversal of the inhibited enzyme; and (d) the hydrolysis of the inhibitor by independent enzyme systems.

Manufacture and Distribution

Discussing manufacture and distribution, Dr. Barnes comments that few accidents or illnesses have been reported among those exposed to pesticides during manufacture. The primary producers have experience in handling toxic chemicals of all kinds and know how to control hazards of this type. Some of the primary producers have extended their responsibilities by advising and controlling the activities of the firms who formulate their products.

Because of the anxiety so often expressed that some unforeseen chronic toxic effects may result from long exposure to pesticides, there has been some interest in watching the health of workers exposed during manufacture. Thus 58 men exposed to chlordane, aldrin, and dieldrin for periods up to 3 years were examined and found to be free of any evidence of kidney or liver disease or other gross disorders. Unfortunately, Dr. Barnes states, there are no adequate records of the degree to which these men had been exposed during the course of their work. Investigations of this type are difficult to organise, and any long term follow up may be made impossible both by labour turnover and changes in the nature of the manufactured materials.

" It would be more satisfactory if some simple chemical or biochemical test could be devised to measure exposure to this type of pesticide," writes Dr. Barnes. " The routine blood cholinesterase determination will check the degree of exposure to organophosphorus insecticides, but there is much less concern about possible chronic effects from these unstable compounds which appear to be rapidly metabolised by the body and execreted.

" The chlorinated hydrocarbon insecticides are more stable and less is known about their metabolism; some are known to be stored in the fat. Hayes states that a beginning has been made in assessing exposure to DDT by measuring the DDA content of the urine, but details are not yet available. A similar approach might be made to the study of workers making related compounds. If a simple method existed for the determination of organic chloride in urine, it might be worth finding out whether an estimation of the excretion of organic chlorides would give some estimate of the degree of exposure. The same procedures would also be valuable in assessing the exposure undergone by workers in the field."

User Hazards

Of user hazards, Dr. Barnes observes that the handling of pesticides during their normal use must inevitably entail the greatest risks of poisoning. The pesticides are applied in many different ways from all types of equipment handled by men and women who may differ widely in experience and general intelligence. A pesticide less toxic to man will inevitably find wider uses than an equally effective one for which special precautions of any kind have to be observed before it can be safely handled. If the incidence of poisoning associated with use of any particular material becomes serious, local or national authorities may intervene in an attempt to control its distribution or use. In some instances serious poisoning may arise as much from the misuse as from the correct use of a product. In order to ensure the safe use of toxic pesticides it may be necessary to exercise certain precautions, but those precautions which are recommended should be as few and as simple as possible. In order that only the appropriate precautions should be recommended it is essential to know how the greatest degree of exposure takes place under each particular condition of use.

" Clearly the biggest risk of acute poisoning is run by those who handle the pesticide in its concentrated form. The early casualties from parathion were among those who diluted or mixed the concentrates. This situation calls for the design of suitable containers and equipment so that the operation of adding the concentrate—liquid or solid—to the diluting water can be carried out with least risk of raising dust clouds or of splashing the skin or clothes. Some suggestions for the design of spouts and fillers have been made."

Regarding the degree of contamination of the skin, Dr. Barnes after reviewing the question, notes that certain observations seem to indicate quite clearly that skin contamination is the most important route of absorption in field work with pesticides. The same conclusion has been reached by others with experience in the control of hazards to pesticide operators.

" The value of rubber gloves is limited and full protective clothing is often impracticable so that the emphasis must be placed on the actual removal of skin contamination by washing. In three unpublished reports coming to the writer's attention the extensive use of parathion in the field has been safely carried out in hot countries by teams relying on washing as the sole preventive measure apart from general care in handling concentrates. There might be a place for including washing at fixed and regular intervals as a standard precautionary measure when handling toxic pesticides."

Parathion has been very extensively used in the Mediterranean area for the control of olive fly, but so far there have been no reports of casualties among those handling parathion for this purpose. The situation although giving rise to no grounds for complacency did indicate that the hazards were amenable to relatively simple control measures. The introduction of organophosphorus compounds of much lower mammalian toxicity should further reduce the potential danger.

Among the many fungicide preparations in common use, those containing mercury must be considered to present the most serious health hazard. Almost all those in common use are skin irritants and care must be exercised when handling concentrates for this reason alone.

Residues in Food

Referring to pesticide residues in food, Dr. Barnes points out that this problem has aroused considerable anxiety both among public health authorities and certain individuals. There have been a number of statements implying that communities might be poisoned by the consumption of food containing such residues.

" The continued lack of positive evidence of harm to the national health in communities where food treated with pesticides is consumed reduced the occasion for alarm or the need for desperate remedies. At the same time, reassurance, if it can continue to be given, needs to be based on whatever scientific data can be assembled. This must show in the first place the actual quantities

of the pesticides which are being consumed and then the relation that such a dose level may have to those doses known to produce the first signs of poisoning."

Staple dietary articles, especially cerial products, may be treated by insecticides during storage and during carriage in international trade. Problems may be presented to communities with limited food supplies for whom the use of pesticides is an alternative to the threat of famine. Similarly, countries such as the United Kingdom relying for 60% of their food from other countries may have no control over the use of pesticides on the crops before they reach them. Investigations here are required on the proper quantities and correct methods of applying different pesticides to ensure effective pest control. The behaviour of individual pesticides needs to be studied in order to find out which persist in the greatest quantities in the food up to the time it is actually consumed. Thus a material driven off readily by heat in cooking might be preferable to a less volatile alternative. Other pesticides might react with the crop as has been shown to be the case with methyl bromide. The reaction products in this case seem to be free of demonstrable toxic effect. In addition it has been estimated that in the U.K. only 0.5% of the wheat crop is ever treated with methyl bromide. On the other hand, ethylene dibromide though absorbed on to the treated grain does not react with its constituents.

" Clearly there are many aspects to this problem of pesticide residues in foodstuff where the first need is for quantitative and analytical data in order to be able to assess the hazard at a stage before the question of the potential toxicity of the pesticides residue arises at all. If codes of practice could be formulated and agreed upon for the effective control of pests under different conditions then accurate determinations of the residues in foods could be made. When this information was available medical opinion could be sought on the magnitude, if any, of the risk being run as a result of the use of pesticides to control the infestation of stored staple foods such as grain."

The use of systemic insecticides offered advantages to the practical entomologist, but added new aspects to the residue problem. The two most widely used materials, schradan and demeton, had now been extensively investigated.

An abstract from " Control of Health Hazards associated with the Use of Pesticides " by J. M. Barnes, and published in "Advances in Pest Control Research " Volume 1.

NEW WORK BY A LOCAL AUTHORITY

by **A. G. DAVIES**, M.A.P.H.I., A.M.Inst.P.C.

". . . . one must be free to order at will, according to the needs of the work and the latest available materials."

NO DOUBT it will come as a surprise to many to be told that the mosquito is a serious nuisance in any part of Britain, but those who live in parts of North West Surrey have cause to be aware of this unfortunate fact. The large stretches of ill-drained common lands and the combination of extensive woodlands have served to create circumstances favourable to mosquito breeding and for many years an intense problem has existed.

We who serve as public health inspectors in the Woking Urban District have been called upon to introduce measures intended to reduce the tremendous nuisance potential and after very careful investigations in 1957, field operations were commenced in late February of this year, a circumstance for which we were later to feel grateful. The date in February was selected having due regard to the views of leading entomologists and especially, perhaps, with the advice of the Entomological Department of the University of London. A material difference of opinion throughout was expressed by several of these authorities, and we would wish to stress that most of the campaign has been essentially of an experimental nature both in relation to the timing of the work and more especially perhaps the selection of insecticides and the concentrations of solutions in which they were conveyed to the areas requiring treatment.

Due to the severity of the weather during the preceding weeks, most of the water on ponds and ditches was frozen when operations began but cold spray was deposited upon iced surfaces. The frozen nature of the ground allowed more tolerance for the manoeuvring of the vehicle and at Smarts Heath, where larvae were collected from stagnant pools beneath ½" ice, complete control of treated water was achieved. Four new species were identified by the British Museum, i.e. *Aedes Rusticus*, *Theobaldia Fumipennis*, *Theobaldia Morsitans*, and *Mochlonyx Culiciformis*.

For some considerable time a 25% DDT emulsion diluted with water to 0.25% was used with good results but limitations occurred by reason of our inability to bring the Tifa equipment within reach of some of the worst points of stagnation on the various commons, especially after the frosts subsided, and a further length of hose was purchased for use with the hand spray attachment. This gave a radius for coverage of up to 100′ but again fell short of requirements, so much so that a large number of pools and ponds were treated with an ordinary hand operated knapsack sprayer. An area of control for this method was developed in Prey Heath where all pools were found to be infested with large quantities of *Aedes Punctor* larvae. After two days, further inspections showed all pools clear—they remained so up to June when the water in all pools subsided with the fall of the ground water.

In addition to the cold spray work, the sewage works was visited on a number of occasions in order to ascertain whether larvae of the *Aedes Caspius* were breeding. On the 1st May larvae were collected from an outlet ditch to the contact beds where water was flowing at an approximate rate of 10,000 gallons per hour; subsequently with the aid of the office breeding tanks and equipment we were able to propagate larvae and pupae which the British Museum identified as *Aedes Caspius* and a species not previously identified in this area, namely *Aedes Vexan*. Five and ten gallon drums were fitted with micrometer drippers and the whole of the effluent from the two filter units was treated with 25% DDT—diluted to the rate of 1 part per million. The equipment worked satisfactorily until the DDT supplies of the original manufacture were exhausted. The use of the cheaper product subsequently caused the units to clog daily and necessitated a good deal of extra visits and alterations to the drip supply. Consequently the beds were not satisfactorily impregnated with DDT in solution. In addition some 200 insecticidal pellets were thrown on the beds in use.

Here we should add that since this work was undertaken no further larvae of the *Aedes Caspius* were identified on the Sewage Works, but some disappointment was occasioned during the middle of July when mosquitoes which appeared on Pyrford Common were identified as *Aedes Caspius*. The conclusion to be drawn, therefore, is that the answer has not yet wholly been found to the several problems which surround the eradication of mosquitoes breeding in and around the Sewage Works.

To spray vast acreages of land accessible to transport is one thing; to approach the problem of marshy tracts well outside the reach of any form of transport including the Land Rover type of vehicle, is another. For some time this particular problem was something of a headache inasmuch as handspraying was too laborious and prolonged to be of any value. Finally a successful answer emerged in the form of the pressure powder blower manufactured by Newton, Chambers & Co. Ltd., an extremely light, mobile tool of exceptional power which gave us all the scope we required. As a result of the acquisition of this piece of equipment we found ourselves perfectly competent to provide complete coverage of spray under the worst possible conditions, and one of the anxieties of the work was eliminated.

An influx of mosquitoes on one particular section of common land became evident well into the summer and a considerable amount of time was spent fogging the area with a 0.3% solution in diesel oil without achieving the desired results. The next effort was with water based insecticides at 0.3% and 0.9% dieldrin with the powder blower to ascertain whether the residual effect on the heather would kill the adult mosquitoes. It would appear from observation that the insecticide concentrate had to be stepped up considerably for adult mosquitoes, and the Dieldrin quantities were raised to give 1.2% Dieldrin and the DDT to give 1% as the diluted rate for both fogging and cold spray work.

The district was covered in a manner which we consider to be the best appropriate to this work and although, as said earlier, concentrated activity occurred at the major seats of infestation, it is true to say that in no case has any area been omitted where there was the slightest possibility of nuisance.

In our considered opinion true results from work of this character can be assessed only after a number of years of application. The problem is very similar to the one experienced in certain coastal areas due to the seaweed fly and a real difficulty will always remain of being able to assess how far one's success is due to the efforts involved or to what extent climatic circumstances have influenced the situation. There were complaints of mosquitoes during the later part of the summer and the Department was aware of cases where nuisance has been experienced. But so far as information was available we consider that the problem has been of substantially less magnitude than on any previous occasion for a number of years, and we believe that the work carried out during the year has been significant in this respect.

Some considerations in relation to the use of insecticides are of interest. As time went on we became obsessed with the view that the traditional method of purchasing materials as applied in the municipal service, was an extreme handicap. Many will know of the procedure for ordering following the receipt of tenders, a practice which might have some justification in routine operations, but quite hopeless where work of a technical nature and of a rapidly

changing character is involved. Insecticidal chemicals are the subject of rapid scientific development and one must be free to order at will, according to the needs of the work and the latest available materials. It is not thought practical, nor indeed economical, to be under any degree of restrictive influence in the use of insecticides merely because of a tendering system of supply. We justify this opinion partly on the grounds of difficulties arising from the use of one particular quality of insecticide, to which reference is made later, and partly to the need to be able to take advantage of the latest developments. Of equal importance is the need to change the formula of the insecticide from time to time, to maintain their effect and to delay the possibility of resistance developing in the host.

We cannot conclude without reference to the staff employed on this work and the handling hazards which were experienced. Some of the insecticides used were especially toxic, particularly when handled under unsatisfactory conditions and in confined spaces, and appear to have an effect on the general health of the operators; this in fact did happen and members of the staff suffered quite frequently from headaches, and in one instance it was found necessary to seek medical advice. A very close regard was paid to these conditions and considerations and the point was not at any time overlooked. We consider that there is a risk involved which, however, is not serious if adequate precautions are taken but in the mixing operations in particular these precautions must be observed.

The district concerned is a comparatively large one and much planning, preparation, operation and research has proved necessary; the hours involved in covering many thousands of acres with spray and fog at the appropriate time is a task which has to be carried out before a full appreciation is obtained of all that is entailed. These columns present but a brief review of what has proved to be a most interesting operation and we look to the future with the hope that repeat measures will bring a permanent degree of success.

. . .

A view of the weed research field at the Experimental Farm, Ottawa, Ont.

General Approach to Chemical Weed Research

The distribution of the Experimental Farm units is such that all of the major weed problems of Canada can be investigated in the locality in which they occur.

The initial chemical attack on these weed problems usually has been empirical. Weeds that have not been controlled by standard applications of hormone-type chemicals have been subjected to more intensive study.

There are a number of weeds such as corn spurrey (*Spergula arvensis*) horsetail (*Equisetum spp.*), wild buckwheat, (*Polygynum convolvulus*) and tartary buckwheat (*Fagopyrum tataricum*) which have not been controlled by standard use of hormone-type chemicals. Life history and other detailed studies of these plants are providing information which gives promise of more effective control.

Wild Oats—The Most Serious Weed

At the present time, the most serious weed in western Canada is wild oats. It has been reliably estimated that this weed infests 75 per cent (30 million acres) of the seeded acreage in the prairie provinces. The estimated crop loss to prairie farmers due to dockage is 50 million dollars and the bulk of this is due to wild oats. Thus, much of the weed research effort in western Canada is directed toward a solution of the problem.

One of the characteristics of this weed which makes it difficult to control is the aberrant dormancy of its seeds. Usually wild oat plants in a crop of grain shatter their seeds before the crop is harvested. These seeds fall to the ground but only a small percentage will germinate during the autumn; a larger percentage, but by no means all germinate the following spring, some remain dormant for several years. Hence, a wild oat infested field may have vast quantities (up to 70 bushels per acre have been recorded) of seed of varying ages in the soil. This makes it very difficult to control wild oats by " growing them out." Present research projects are aimed at finding out the causes and nature of this dormancy. The most hopeful avenues of chemical control seem to be the development of chemicals or practices which would completely destroy the viability of the seeds in the soil or alternatively break the dormancy of all seeds in the soil so that they would germinate and could be destroyed by cultivation. Some selective chemicals are available which provide a measure of control of wild oats growing in broad leafed crops such as sugar beets or flax. However, the major need is to eliminate wild oats from millions of acres of grain land.

4 ounces of 2,4-D per acre effectively controls mustard in grain. Plot in right foreground was not spraved.

May 1st, 1957—Dalapon 10 lbs. per acre applied September 22nd, 1956, plowed October 7, giving excellent control of quack grass.

Green Foxtail and Lamb's Quarters were controlled in this corn by 2 pounds per acre of C.M.U. applied as a pre-emergence spray. The corn was not damaged.

A good deal of research has been done on cultural control of wild oats and the recommended principles are pretty well established. Results of a number of experiments indicate that delayed seeding of a grain crop (preferably barley) in the spring is the most effective cultural control method. Long term sod rotations greatly reduce wild oat incidence. Fall tillage of grain fields after harvest is a helpful practice in some seasons.

Perennial Weeds

Deep-rooted perennial weeds infest approximately 100,000 acres in western Canada. A number of these weeds are temporarily controlled by hormone type chemicals but re-growth occurs from the rootstalks. It would be desirable to have a relatively slower acting chemical which would not kill back the vegetative growth until the herbicide has been conducted to the roots in lethal quantities. In this connection, some fundamental studies on translocation of herbicides are underway.

Projects dealing with perennial weed eradication programmes are being carried out at several stations. These programmes include application of herbicides followed by cultural and cropping practices which tend to hold the weed in check and permit re-treatment of surviving plants with chemicals.

WEEDKILLERS—

A Decade of New Developments

by R. S. L. JEATER, B.Sc. and H. P. ALLEN, B.Sc., Ph.D.

HOW OLD is old-fashioned? This will obviously depend on the subject under discussion but in the case of weedkillers ten years is a good answer to that question!

Since the end of the Second World War, the use of chemicals for weed control has developed at a tremendous rate. Until 1945 cereal growers had the choice of such chemicals as sulphuric acid, copper sulphate and cyanamide for the chemical control of weeds in their crops; the selectivity of these weedkillers depended largely on morphological differences between cereals and broadleaved weeds. These chemicals had to be applied in 80-100 gallons of water per acre as their effectiveness depended on contact with the weeds, hence their name, "contact selective weedkillers."

Immediately after the war a new and more efficient selective weedkiller, dinitro-ortho-cresol (DNC), became very popular but its position was assailed by the rapid development of two chemicals of an entirely novel type, MCPA (2-methyl-4-chlorophenoxyacetic acid) and 2,4-D (2,4-dichlorophenoxyacetic acid) for weed control in cereals and grassland. Of the two, MCPA has the wider application on cereals. Their selectivity depends on physiological and biochemical differences between grasses (and cereals) and broadleaved weeds. Thus was introduced the principle of systemic weedkilling.

Like DNC, MCPA and 2,4-D could deal with many young annuals. Unlike DNC, MCPA and 2,4-D could suppress many perennial broadleaved weeds; furthermore, these two hormone weedkillers, being systemic, could be used in volumes as low as 6 gallons of total spray per acre by ground machine. More recent aerial experiments have shown that these hormone weedkillers may be applied successfully at lower volumes still, i.e. 1½-2 gallons per acre. In addition, the poison hazard of DNC was a considerable disadvantage.

On the other hand, DNC was able to deal with cleavers, mayweed and corn marigold, against which MCPA and 2,4-D have little effect. For this reason, until 1957, these three chemicals plus DNBP (a relation of DNC with a similar toxic hazard, especially useful for the control of young annual weeds in undersown cereals) formed the modern armoury with which the cereal grower could fight his weeds.

New chemicals

In 1957 two new chemicals became available to the farmer. These were, sodium monochloracetate (SMCA) and 4-chloro-2-methylphenoxypropionic (CMPP) which can control many weeds resistant to MCPA and 2,4-D

in cereals and are safer to use than DNC. SMCA is extremely effective against cleavers, chickweed, redshank, black bindweed and spurrey but it is a contact weedkiller. CMPP is a growth regulator closely related chemically to MCPA. Applied in from 20-100 gallons of water per acre and at 2-2¾ lb. total acid equivalent per acre it is effective against a range of weeds similar to those suppressed by MCPA but, in addition, it is effective against cleavers and chickweed—the latter being the more susceptible of the two. It can be applied safely to winter and spring wheat, barley and oats from the four leaf stage through to heading. It is rather slow-acting when applied in colder weather in early spring. By virtue of its chemical constitution it is believed that only half of the "CMPP" content is active as a weedkiller; this means that the rates necessary for success are approximately twice those of MCPA, hence the chemical is more expensive than MCPA and, for that reason, must be regarded as a supplement to MCPA rather than as a replacement for it.

In 1958 CP. 18-15, a mixture of trichlorobenzoic acid (TBA) and MCPA was introduced commercially and it is claimed that it will control those weeds suppressed by MCPA plus cleavers, mayweed, redshank and white campion, but it is less effective than CMPP on chickweed. This chemical is slow-acting but is relatively unaffected by cold weather. The action of the TBA constituent is different from that of the growth-regulating weedkillers in that it does not cause the characteristic epinasty and with many weeds its effect is one of partial suppression of growth and prevention of flowering, rather than complete kill.

Application

Timing of application of CP. 18-15 to cereals demands more care than with MCPA or CMPP. Spraying before the crop has tillered may result in deformed heads; furthermore, on no account should CP. 18-15 be applied to cereal crops after they have reached the "jointing" stage.

Another drawback to MCPA and 2,4-D was the setback to clover caused by these chemicals in undersown cereals. Dinitro 2-*sec*.-butyl-4,6-dinitrophenol (DNBP) could be used when the clover had reached the 2-3 leaf stage or DNC could be applied prior to emergence, but both chemicals were ineffective against perennial weeds. In 1954, however, it was found that 2-methyl-4-chlorophenoxybutyric acid (MCPB) and 2,4-dichlorophenoxybutyric acid (2,4-DB) had only a very slight retarding effect on clovers. Both these chemicals may be used with safety in undersown cereals, young leys (provided the clovers have reached the spade leaf stage) and established pastures. These relatives of MCPA and 2,4-D are in themselves quite inactive as weedkillers and their activity depends on their being converted by weeds into MCPA and 2,4-D.

Thus the spectrum of weeds against which MCPB and 2,4-DB are effective is more limited than with MCPA and 2,4-D-runch is quite resistant to these compounds; charlock requires for its control a rate much higher than that of MCPA and indeed one manufacturer is offering an MCPB-MCPA mixture in an effort to overcome this disadvantage.

2,4-DB is safer than MCPB on lucerne and it is reasonably effective against redshank, black bindweed and pale persicaria. On the other hand, MCPB may be applied on cereals at any time from the first leaf stage up to heading, whereas 2,4-DB should not be applied to spring wheat before the 5 leaf stage. Moreover MCPB may be used for the control of weeds in certain varieties of peas, whereas 2,4-DB is not safe for this purpose. It is fair to conclude from the foregoing that there is a place for both MCPB and 2,4-DB in British agriculture, once again to supplement rather than replace MCPA and 2,4-D.

The use of weedkillers on grassland has been under close study for the last decade, but the development of this technique has been much slower than on cereals. This is understandable because the problem, involving as it does the grazing animal and the need to preserve the clover content of the sward, is rather more complex than the weed problem in cereals. Furthermore, until the appearance on the market of the butyric compounds in 1955, there was no treatment which was really safe in young leys containing white clover.

In permanent pasture clover is well established and can withstand the rates of MCPA and 2,4-D necessary to control the more important grassland weeds, but the benefits of killing weeds in pasture are perhaps not so obvious as is the case with cereals. Techniques for measurement of such benefits in terms of increased live weight or milk yield of cattle are not yet available. Nevertheless these benefits are very real, in terms of better grazing and increased grazing provided proper management accompanies the weedkiller treatment. In other words, the full benefit of the use of weedkillers on

pasture will only be realised if this treatment is part of a well thought out grassland improvement programme.

With MCPA, 2,4-D and the butyrics many of the main weeds of grassland may be tackled effectively, e.g. creeping and crowfoot buttercup, creeping thistle and horsetail may be dealt with by MCPA or 2,4-D, MCPB or 2,4-DB; the common rush is susceptible to MCPA and 2,4-D; and even ragwort, one of the most pernicious of pasture weeds, can be brought under control with repeated applications of MCPA or 2,4-D derivatives over a period of two or three years.

Major Problem

The general problem of grass weeds represents perhaps the major weed problem facing farmers today, not only in Britain but everywhere in the world. This embraces many particular menaces such as wild oats in cereals and row crops, black grass in grass seed crops and cereals; perennial grasses in arable land and overseas in plantation crops like rubber, tea and sugar. Considerable progress has been made in tackling these problems but much work is still to be done.

Sodium trichloracetate (STCA) and propham (isopropylphenyl-carbamate) have both achieved some success for control of wild oats in peas and sugar beet. In more recent years a group of chemicals, the N-substituted a-chloroacetamides, have been tested for wild oat control in a number of crops. These chemicals have to be applied to the soil prior to the sowing of the crop and all are more toxic to grasses than broadleaved weeds. As with all herbicides acting through the soil, these chemicals are affected by many environmental and edaphic factors and the results so far obtained have been very variable.

On perennial grasses like couch and creeping bent, dalapon is perhaps the most effective chemical known so far. At 10-15 lb. per acre applied as an autumn treatment on stubble before ploughing, it will cause very considerable reduction in couch infestation and a spring crop can be sown without fear of damage from weedkiller residues in the soil. Here again, however, we have not yet learnt how to eradicate couch safely from a growing crop.

Overseas

Overseas, lalang (*Imperata cylindrica*) in Malaya, representing undoubtedly the biggest single perennial grass problem in the world, has bowed its head to some degree to STCA, and, more recently to dalapon. The drawbacks to these treatments are expense and phytotoxic hazards to the growing rubber; both chemicals can cause delayed action damage in rubber plantations and the most popular treatment at the present time remains that of multiple applications of sodium arsenite, which kills by repeated defoliation.

African couch grass (*Digitaria scalarum*) in sisal, has become less of a problem since the advent of STCA and dalapon; on the other hand nut-grass (*Cyperus rotundus*), a sedge, has proved a very tough proposition. It is a severe problem in maize in South Africa, especially in Natal, also in sugar, and is troublesome in many other countries and no chemical at present in use can be said to be the complete answer to this weed. The use of MCPA and 2,4-D as pre-emergence weedkillers (or, some claim, very soon after the emergence of the nutgrass shoots) can hold back the development of an infestation for a given time, but complete eradication is a goal not yet attained.

2,4,5-T, the brush-killing chemical very closely related to 2,4-D and MCPA, is effective against brambles and gorse and will kill many woody shrubs and tree species infesting valuable plantations. Its use for killing old rubber trees in Malaya has developed considerably in the past few years.

Bracken is a major problem in many areas, notably in the upland regions of Scotland and Wales. Until recently this could only be tackled by cultural means or by the application of large doses of sodium chlorate. However, within the last year it has been found that dalapon will suppress the growth of bracken and even more recently it has been reported that a new chemical from the United States, known under the code number LFN.251, has shown considerable promise for the control of bracken in preliminary trials. This chemical has the advantage that unlike dalapon it does not damage the grasses associated with bracken.

Total Weedkillers

In the field of total weedkillers, sodium chlorate and sodium arsenite were pre-eminent until the discovery that certain phenyl-substituted ureas could be used as persistent non-selective weedkillers on railways, roadsides and industrial sites.

The best known of these chemicals is monuron, (N-(4-chlorophenyl)-N^{1}N^{1}-dimethyl urea.) This chemical acts

through the soil, is only slightly soluble in water, and is very persistent. It was the first organic compound to exhibit soil persistence and it had the advantages over the inorganic chemicals in use of being of low toxicity and non-corrosive, and in not having a fire hazard. Monuron is extremely effective on a wide range of annual and shallow rooted perennial weeds but because of its low solubility it is very slow acting and is not highly effective against deep rooted perennials.

Diuron (N-(3,4-dichlorophenyl)-N^{1} N^{1}-dimethyl urea) fenuron ((N-phenyl-N^{1} N^{1}-dimethyl urea)and neburon (N-N-butyl-N^{1}-(3,4-dichlorophenyl)-N-methyl urea) are persistent herbicides closely allied to monuron both chemically and biologically. Diuron is less soluble in water and more persistent than monuron, while fenuron is more soluble and less persistent. Both appear to be non-selective but neburon, which is highly insoluble in water, may prove effective for pre-emergence control of weeds in deep planted crops.

A recent addition to the range of non-selective weed-killers is simazin (2-chloro- 4,6-bis-) ethylamino) -s-triazine). This chemical, although slower acting than monuron, has proved to be effective against a wide range of weeds. It has a low water solubility and is very persistent. It is primarily taken up through the root system and is most effective on plants soon after they germinate. At low dosages it has proved effective as a residual pre-emergence weedkiller, particularly in maize.

Recent Discovery

The most recent discovery in this search for chemicals with herbicidal activity is 1:1^{1}-ethylene-2:2^{1}-dipyridylium dibromide, a quaternary ammonium compound. In preliminary tests the water soluble chemical has shown very patent herbicidal properties. It is extremely rapidly absorbed by the plant, readily translocatable and quick in action.

Many annual weeds have proved very susceptible to the chemical and it has also shown promise as a potato haulm killer and as a crop desiccant.

The foregoing is a progress report of developments, and like all progress reports, presents a mixed picture of successes, problems under study and unsolved problems. It should be obvious to anyone, however, that the tempo of discovery has been rapid and the volume of weedkiller research has been tremendous during the past ten years and this augurs well for the future.

The photographs (above and below) are of Eichhornia crassipes filling the Congo after treatment by hormone weed-killer.

EICHHORNIA CRASSIPES is reported to have been seen in the White Nile. Even more alarming for Western Europe is that another form of the plant, capable of withstanding Northern winters, has been observed in one of the Swiss lakes.

This plant, a native of Brazil, has spread in comparatively recent years, to the East Indies, large parts of Southern India, Ceylon, and Central Africa, particularly the Belgian Congo. For some years, it seems the Belgian authorities have been trying to prevent the spread of the plant in a north-easterly direction along the Congo River.

According to reports, the plant is to be seen in " considerable quantities " in the White Nile and the Bahr el Gebel.

Apparently the weed is very adaptable: it is able to exist in conditions which range from open water to swamp.

Fluoroacetamide as a Systemic Insecticide

by W. A. L. DAVID, M.A., Ph.D.

IT has been known for some time that many fluoroacetates are highly toxic to mammals[1-3] and that some are very effective insecticides.[4-5] Sodium fluoroacetate was first investigated as a systemic insecticide because it was known to occur in the South African plant gifblar (Dichapetalum cymosum) and it therefore seemed possible that it would be tolerated by other plants. It proved to be highly effective and superior to schradan.[6]

Unfortunately sodium fluoroacetate is a very dangerous poison and its use as an insecticide could hardly be contemplated. As a result of this work however other compounds were tested and fluoroacetamide was claimed to be effective and less dangerous than sodium fluoroacetate.[7] It is less dangerous for three reasons. The L.D.50 to mice is about 15mg./kg. body weight compared with 1-2 mg./kg. body weight for sodium fluoroacetate. Secondly in rats acetamide has been shown to act as an antidote and thirdly fluoroacetate acts more slowly.

Biological tests have been carried out with bean aphis, *Aphis fabae* Scop., on broad beans, cabbage aphis *Brevicoryne brassicae* L., the peach-potato aphis, *Mysus persicae* Sulz., on young cabbage plants and the eggs and larvae of the large white butterfly, *Pieris brassicae* L., also on young cabbage plants.

When leaves bearing *A.fabae* and *B.brassicae* were dipped into solutions containing a wetting agent fluoroacetamide killed all aphids at 0.001% and was superior to schradan. The solutions, up to 0.1%, gave poor kills of *Pieris* 4th. instar larvae but 85% of the eggs dipped in this concentration failed to hatch and 70-80% of the larvae that did emerge were killed.

As a systemic insecticide poured on to the soil fluoroacetamide gave 100% kill of *A.fabae* when applied at 2 mg. (in 20cc. solution) to 400 g. of moist compost. It was therefore superior to schradan. In similar tests *B.brassicae* was killed by a dose of only 0.2 mg. applied to the compost under the same conditions. Fluoroacetamide poured on to the soil did not prevent the eggs of *Pieris* on the leaves of cabbage plants from hatching (as some systemic insecticides do) and to kill all the young larvae which hatched a dose of 10mg. fluoroacetamide per 400 g. compost was required.

When taken up by broad bean plants through the cut tap roots[6] the approximate L.D.100 in mg. per kg. of fresh plant tissue for *A. fabae* was fluoroacetamide 0.09 to 0.9, sodium fluoroacetate 0.7, schradan 50. When taken up through the petioles of leaves cut from young cabbage plants 5mg. fluoroacetamide or 50 mg. schradan per kg. of fresh plant tissue gave a complete kill of *B.brassicae*. To prevent *Pieris* larvae growing 20mg./kg. of fluoroacetamide was required. This is a comparatively heavy dose but it may be compared with the dose of more than 2900mg./kg. required with schradan.

When applications were made to the older leaves against all three species of aphids feeding on the younger leaves of their host plants fluoroacetamide was very effectively translocated and all aphids were killed at dosages which showed that it was at least as effective as sodium fluoroacetate and in varying degrees superior to schradan. These results will be published in greater detail elsewhere.[8]

The results obtained show that fluoroacetamide is an effective systemic insecticide and its use on certain crops is now permitted. Recommendations about its safe handling and use are given in a revised edition of the leaflet on fluoroacetamide published in July 1958 by the Ministry of Agriculture, Fisheries and Food. Aqueous formulations containing not more than 1% active ingredient need not be included in the Agricultural (Poisonous substances) regulations. Formulations containing more than 1% should be included as a second Schedule Part II substance.

The use of fluoroacetamide at any time on non edible crops is permitted. It may also be used on sugar beet as it is considered that in view of the subsequent processing of the crop the consumption of the products will involve no hazard. Provided that not more than two

applications totalling 6 oz. of the active ingredient per acre are made, the last not less than five weeks before harvest, the tops may be fed to animals. There is at present insufficient evidence on which to base recommendations for the use of fluoroacetamide on other edible crops.

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NEW WARBLE CONTROL

Apparently the Department of Agriculture of Eire, has obtained promising results on the new systematic control of warbles.

Warbles are estimated to lose Eire some £2,000,000 each year in poor hide prices and general loss in condition of animals.

The appearance of warble has, in the past, reacted against the country's foreign trade by causing her reputation as a premier cattle producer to suffer.

Reports indicate that Dieldrin may be sprayed from an attachment fixed to the exhaust of a Land Rover and it is claimed that in this way 1 lb. of the insecticide can kill as many locusts as 20 lb. of poisoned bait. Another advantage is the persistency of the insecticide. It will kill locusts at the hopper stage even when used at a rate of under a quarter of a pint per acre, and once sprayed it will last for four or five weeks. Rain has little effect on its potency.

The method is said to have been used successfully by the Desert Locust Survey Organisation over considerable areas of Libya and Ethiopia.

The Association of British Chemical Manufacturers

THE ANNUAL GENERAL MEETING of The Association of British Chemical Manufacturers was held in London on the 9th October. The Annual Report of the Association was adopted and the following are extracts from that Report:

Notification of Pesticides

The voluntary Notification and Clearance Scheme for toxic chemicals used as pesticides which was referred to in the last Annual Report has been in operation for just over a year and appears to be working satisfactorily apart from some delay in the issue of recommendations. Those recommendations which have been prepared are available on request from the Ministry of Agriculture, Fisheries and Food. Two panels set up to prepare guidance notes on (*a*) toxicity data, and (*b*) residue data to be submitted in support of a notification have almost completed their work. When these reports are finalised a meeting will be held with the Interdepartmental Advisory Committee to consider them and to discuss experiences in the operation of the scheme since its introduction.

Exports Committee

During the year, the Committee kept under review developments in connection with the United Kingdom's progress towards Western European Integration. Detailed examination of the proposals was, however, transferred to the newly constituted Free Trade Area Committee. Among the topics considered by this Committee was the effect of a Free Trade Area upon those members who were not actively engaged in regular export business. The Exports Committee were, therefore, requested to consider how they might stimulate and assist such members in investigating the possibilities of export.

After a full discussion, the Committee decided that a more detailed appreciation of the situation was needed. Consequently, an approach is currently being made to the Regional Committees for their views. At the same time a questionnaire is being prepared for circulation to all members of the Association. The answers to this document will, it is hoped, provide the information on which the Committee can base their future efforts.

CHEMISTRY TO PROTECT THE CROPS IN THE USSR

by **V. KOSOV**

IN THE USSR chemicals play a decisive part in protecting agricultural plants against pests and diseases.

This does not exclude other means of protection of plants, in particular, the biological method in which a number of cases yield a still better effect.

Chemical protection of crops and plantations has become most widespread during the past ten years, in which the chemical industry of our country considerably increased the output of chemical fertilizers and means of combating agricultural pests, weeds and diseases of plants.

In 1957, approximately 390,000 tons of different preparations were used in the USSR to combat agricultural pests and diseases, as against 53,000 tons in 1940. A considerable amount of the chemicals used in agriculture are manufactured in the form of finely-dispersed powders, used to spray the crops and plantations.

This is determined by the huge amount of work carried out by the state in the struggle against such pests as locusts, the wheat bug and the wheat cutworm, where the most efficient results are obtained from the use of DDT and Hexachlorcyclohexane dust.

For industrial crops, preparations requiring a lesser expenditure of liquids are being more and more widely used in recent years. In particular, in order to protect the cotton plants against the red spider and a number of other sucking insects, mercaptophos and other phosphororganic poison-chemicals are used which are absorbed internally by the plant.

Extensive use is being made of different fungicides—both in treating the seeds before sowing and in combating various diseases of plants in the process of their growth. Among these are granosan, copper, trichlorphenolate, tetramethylthiuram-disulphide, blue vitriol, etc.

The majority of the work connected with the struggle against pests and diseases of field crops and forests is carried out in the USSR with the help of tractor-drawn equipment, apparatus installed on trucks, or from the air. In orchards, vineyards, and also truck gardens horse-drawn and hand-operated apparatus is used.

In the USSR no special records are kept of crop losses due to pests and diseases of plants, as all the measures to combat these are intended to prevent losses of the harvest. It should be said, however, that on these farms where no measures are taken to combat agricultural pests and diseases of plants greater crop losses are observed. In 1957 in a number of state farms and collective farms of Kustanai and other regions of the Kazakh SSR, where the necessary measures were not taken to combat the cutworm, the crop yield in the fields attacked by this pest were by five to six centners lower than in the fields where the cutworm did not appear.

In protecting agriculture against pests and diseases a certain importance is attached to quarantine measures, by means of which it was possible to prevent the penetration into the USSR of such pests as the cotton moth, the potato moth, the Colorado beetle, the Mediterranean fruit fly, the cabbage (white) butterfly and other injurious insects.

Some of the preparations used to combat the pests and diseases of plants are also efficacious in destroying injurious insects. These are, primarily, DDT and hexachlorcyclohexane preparations, which are widely used to destroy flies, mosquitoes, gnats, gardelies, horse-flies, etc.

Broad area pest control

Sovfoto

All poison chemicals are preliminary tested in the research institutes of the USSR Ministry of Public Health, which establishes the degree of their toxicity as well as the residual effect upon agricultural products of the poison chemicals used to treat the crops. On the basis of this research data, the USSR Ministry of Public Health has established the maximum permissible residual content of poison chemicals in different products. For instance, the presence of any quantity of DDT in grain or milk is absolutely prohibited. In seasonal products —fruit or vegetables—this chemical may be present within the limits of not more than 1 mg. to 1 kg. of, the product. The maximum permissible content of hexachlorcyclohexane in food products has been established as from 1 to 1.5 mg. of the preparation to 1 kg. of the product.

The organs of the public health service determine the obligatory conditions as well as obligatory precautionary measures, to be adhered to in using poison chemicals which present a danger to the health of human beings. Such chemicals include cyanic, phosphororganic and mercurorganic preparations. Nearly all the preparations used in the USSR to combat agricultural pests and diseases of plants are manufactured by Soviet industry. The only exceptions are some phosphororganic preparations as well as herbicides which are as yet produced in insufficient quantities in the USSR. There is also a certain shortage of seed treating preparations. However, in view of the measures for speeding up the development of the chemical industry mapped out by the government these shortcomings will be eliminated in the near future and Soviet agriculture will be supplied with chemicals in sufficient amounts and in a wider assortment. At present, great attention is being paid in the USSR to the development of the biological and, in particular, microbiological, method of combating pests and diseases of plants. This, however, will not result—at any rate immediately—in lowering the role of the chemical method. Soviet researchers are working to create more effective preparations which will make it possible to protect the crops and plantations still more reliably against pests and diseases and thus to increase the output of agricultural produce.

The Council for Scientific and Industrial Research has decided that research on the following subjects should be undertaken at the Forest Products Research Laboratory:—

(i) the pulping properties of home-grown timbers.
(ii) more work on the general properties of home-grown timbers.

An additional scientific officer will be appointed to take charge of the work on pulping. Otherwise all the staff required are to be provided by transfer from other existing work at the Laboratory.

The Research Council has also decided that it is not possible to continue indefinitely at the public expense all the work which is at present carried out on timber bending, wood working, composite wood and wood protection. The value of the work is not questioned, but it is considered that the industries concerned which benefit from the work should do it themselves, or pay for it to be done.

The Department is, therefore, informing the industries concerned that the D.S.I.R. will diminish progressively its expenditure on work in these fields, and will end it in five years' time. It will thus be open to industry to carry out the work or to pay F.P.R.L. to do it.

NEWS OF THE INDUSTRY

The Queen has approved the appointment of Dr. Robert Brown, B.Sc., Ph.D., F.R.S., to the Chair of Botany at Edinburgh University. At present Dr. Brown is the Director of the Agricultural Research Council Unit of Plant Cell Physiology in the Department of Agriculture at Oxford.

The Chair was previously held by the late Sir William Wright Smith. In addition Sir William held the Regius Keepership of the Royal Botanic Garden, Edinburgh, to which post Dr. Harold R. Fletcher was appointed last June. The separation of the two posts was made necessary by the increase in the amount of work attached to both posts.

Dr. Brown, who is 50, was born in Cairo, and came to this country at the age of 15, when he attended Skinners School, Tunbridge Wells. He graduated B.Sc. in Agriculture at the South-eastern Agricultural College, Wye, Kent, in 1928, and for the next six years was a lecturer in the Biology Department, Seale-Hayne Agricultural College.

He resigned his post in order to study for an Honours degree at the Imperial College of Science and Technology taking his B.Sc. in Botany with first class honours in 1936. He then spent four years in research at the Imperial College, being awarded his Ph.D. in 1940.

Since then he has been in turn Assistant Lecturer in the Botany Department at Manchester University; Lecturer in the Botany Department at Bedford College, University of London, Senior Lecturer, then Reader, in the Department of Botany, University of Leeds, Professor of Botany at Cornell University. He has been at Oxford the last five years.

His special research interests have been the physiology of germination and the physiology of the cellular process involved in growth and differentiation.

Mr. H. T. Loftus-Tottenham, Director of Messrs. Chase Protected Cultivation, Ltd., Shepperton, Middx., has just left on a tour of the U.S.A. and Canada, visiting California and various places on the West Coast of America, then on to Vancouver and returning via New York. This trip is to finalise arrangements for the franchise in both countries for " Sea-Magic " paste liquefied seaweed organic leaf-spray plant food, soil conditioner and pest repellent. " Sea-Magic " has, during the past season, been tested as a leaf-spray in California on 117 different crops with results that are in all cases excellent and, in many cases, phenomenal, it is claimed.

Edward R. Schumann has become a district representative of the National Plant Food Institute, with offices at St. Paul, Minn., U.S.A.

A graduate of the University of Illinois College of Agriculture where he received his Bachelor of Science degree in 1954 and his Master of Science degree in Agronomy in 1956, Mr. Schumann will work in the states of Minnesota, North Dakota, South Dakota and Wisconsin.

Two representatives of African Pyrethrum—Mr. R. T. Mytton Watson, deputy Chairman of the semi-official Pyrethrum Board of Kenya and N. H. Hardy, O.B.E., executive officer of the board, have just completed a tour of the United States and Britain.

While in London Messrs. Mytton Watson and Hardy reviewed not only sales potential, especially in West Germany where a special promotion drive is under way, but also current research developments into synergists.

In another field Mr. Hardy announced the appointment of Mr. Robin McLellan, scientist son of a prominent Kenya farmer and pyrethrum grower, as representative in Continental Europe of the recently created African Pyrethrum Technical Information Centre (APTIC).

APTIC, under the direction in London of European Operations Executive, Dr. T. F. West, gives advice to insecticide manufacturers about uses of pyrethrum. It will shortly produce for manufacturers a "recipe book" entitled *African Pyrethrum Formulators' Manual.*

AROUND THE EXHIBITIONS

International Pre-Packaging Exhibition, London: 7th-9th October.

William Palfrey Limited, of 24 City Road, London, E.C.1, showed 2-ply " Palfsacks " for the pre-packing of potatoes; a new paper—a Kraft paper—with a definite, though imperceptible, stretch in both directions (this is *not* a crepe paper); and " Nevermold " 101 Speciality Paper, the purpose of which is to prevent rotting and deterioration of the container through the effects of water, moisture, fungus etc. An indication of the value of the " Nevermold " 101 inner play, is found in the protection afforded to potatoes against the inroads of pests, in particular the potato root eel worm.

National Association of Groundsmen: London, 1st-2nd October.

This exhibition was well supported and those showing included The Cannock Agricultural Co., Ltd., Carters Tested Seeds Ltd., The Dorman Sprayer Co., Ltd., Fisons Ltd., Maxwell M. Hart (London) Ltd., The Holt Weed Breaker Co., Imperial Chemical Industries Ltd. (Plastics Division), International Toxin Products Ltd., Frank Keep (1958) Ltd., Kestrel Engineering Co., Ltd., Lloyds and Co., Ltd., May and Baker Ltd., T. Parker and Sons, Quillot Ltd., Sofnol Ltd., Sutton and Son Ltd., Synchemicals Ltd.

The Motor Show, London: 22nd October-1st November.

Courtalds Limited showed a brand new fabric for car upholstery, "Duracour" produced by the company's Textile Division. Made from spun-dyed " Fibro," " Duracour " is treated with a newly-developed special permanent finish.

The fabric is moth-proof.

NEWS OF THE INDUSTRY

The formation of a new subsidiary company has been announced by Sir Clavering Fison, the Chairman of the Fison Group of Companies, at a meeting at Chesterford Park Research Station of representatives of the Canadian Press and Government.

Fisons (Canada) Limited was formed in July of this year. The directors of the Company include Mr. A. Wormald (Commercial Director of Fisons Limited and Chairman of Fisons Pest Control Limited), Mr. W. Abel-Smith (Fisons Limited) and Prof. A. W. A. Brown (University of Western Ontario).

The Agricultural Chemical Department of Fisons (Canada) Limited will commence trading on the 1st October 1958, from offices at 1893 Davenport Road, Toronto, 9. It will be responsible for the development, promotion and marketing in Canada of the agricultural chemicals of Fisons Pest Control Limited and J. R. Geigy, S.A., of Switzerland. A team of technical experts has been at work throughout the year gaining a sound practical knowledge of these products, many of which will be new to the country, under Canadian conditions.

Fisons interests in Canada go back to 1930 and include investments in International Fertilizers Limited of Quebec and St. Johns, and Fine Chemicals of Canada Limited, of Toronto. In recent years a growing volume of export business has been built up by a subsidiary company, Benger Laboratories Ltd., through their Canadian branch in Toronto and by Fisons Pest Control Limited.

The following is a list of the chemicals which will in the first instance, be marketed in Canada:—

Blitane	Agricultural fungicide
Blitox	Agricultural fungicide
Chlorbenzilate	Miticide for fruit
Diazinon	General purpose insecticide
Legumex	Weedkiller for use in legume crops
Methoxychlor	General agricultural and livestock insecticide
Phenoxylene	Weedkiller for selective use in oats and flax
Simazine	Selective weedkiller for corn and for use in industrial weed control

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In order that Fisons Pest Control can further concentrate their technical and commercial efforts in providing an even better service to British farmers, the Company has recently concluded an agreement with The Murphy Chemical Company of Wheathampstead, who are specialists in the horticultural field, whereby Murphy's will be responsible for the distribution of all those crop protection chemicals suitable for use on horticultural crops and on hops, throughout the United Kingdom.

The Fisons Pest Control chemicals which Murphy's will be distributing are:—

(1) Diazitol—formulation containing Diazinon for control of aphis and other fruit pests.

(2) Phenatol—formulation containing Phenkaptone for the control of red spider.

(3) Pestox 3—systemic insecticide based on Schradan for use on hops.

(4) Pestox Plus—systemic and contact insecticide for use on hops.

(5) Blitox — wettable copper oxychloride fungicide for use on hops.

(6) Blidust — copper coated dust for use on hops.

All enquiries relating to these products for horticultural purposes should in future be addressed to The Murphy Chemical Company, Wheathampstead, St. Albans, Hertfordshire.

Cooper, McDougall & Robertson Ltd. announce that the Company has sold its holding of £500,000 13% Cumulative Preference Shares in Plant Protection Ltd., to Imperial Chemical Industries Ltd. for £1,000,000 under an agreement whereby the proceeds have been used to subscribe for £1,000,000 new 5% Cumulative Preference Stock of Imperial Chemical Industries Ltd. The agreement also provides for maintenance of the income hitherto enjoyed by Cooper, McDougall & Robertson Ltd. from the Preference Shares in Plant Protection Ltd.

Preliminary price-list for 1958-59 has now been issued by Plant Protection Ltd., of Yalding, Kent.

Attention is drawn to the well-known " Eureka " range of products now being handled by Plant Protection Ltd., at Yalding. The "Eureka" name and pack design will continue but, for the convenience of customers selling both ranges, " Plant Protection " and " Eureka " lines are now listed together to simplify ordering, delivery and payment of accounts.

The Ministry of Agriculture, Fisheries and Food has announced schemes for the inspection and certification of strawberry plants. There is likely to be a shortage of certified strawberry runners this autumn owing to the outbreaks of Red Core disease in certain stocks, including Elite stocks being grown by the Nuclear Stock Association.

Poultry keepers and auctioneers in England and Wales have been reminded by the Ministry of Agriculture, Fisheries and Food, that the holding of auction sales of store poultry is prohibited during the months of November and December and that no licences will be issued for such sales during these months.

Farmers and seedsmen sending samples of seeds for testing to the Official Seed Testing Station are asked to enclose the samples in the pre-addressed standard packets which may be obtained on application to the Chief Officer, Official Seed Testing Station, Huntingdon Road, Cambridge, at 2s. 0d. for 25 or £2 for 500.

NEWS OF THE INDUSTRY

An important addition to the nation-wide Celcure treating organisation is the installation by Montague L. Meyer Limited, of a large vacuum and pressure impregnation plant at their London (Millwall) premises.

The new plant is equipped to carry out standard Celcure treatment which is being extensively employed throughout the country for the protection of timber against wood-destroying fungi, insects and marine borers. The plant also operates treatment with Celcure " F ", a new material which combines the full protection of standard Celcure with a very high degree of flame-proofing.

This dual purpose plant has been designed and erected by Strongwork Engineering Limited, Romsey, Hants. in conjunction with the company's own engineers. Timbers up to 50 feet in length can be treated, in quantities up to 5 Standards per charge. Incorporated in the construction and layout are the most up-to-date methods for the rapid handling and efficient treatment of timber with the minimum amount of labour. The wood is hardly touched by hand from beginning to end.

To achieve this an extensive concrete apron (120' x 80') has been laid round the plant to allow fork lifts to operate freely, without being impeded by piles of timber awaiting treatment or collection. Timber for treatment is loaded to the plant bogies either by fork lift from the stacks or customers' vehicles, or directly from the saw-mill, into which the bogey tracks are extended. The entire plant area is flood-lit, and treatment can if necessary continue day and night throughout the year.

The plant operates at pressures up to 200 lbs./sq. in. and the treatment cylinder is fitted with a " Stronglock " door operated by oil pressure which is opened or closed in 45 seconds. The alternative use of either the preservative or flame-proofing liquids in the same cylinder and pumps is made possible by the compatibility of Celcure and Celcure " F " solutions—an important advantage evolved exclusively by the Celcure laboratories.

Montague L. Meyer Limited carry very extensive stocks of softwood, hardwood and plywood in their sheds which cover six acres adjacent to the plant. These new facilities will enable them to meet all specifications and enquiries for pressure preserved or flame-proofed timber.

A serious disease of apple and pear trees which is new to this country has broken out, mainly in Kent, states the Ministry of Agriculture, Fisheries and Food.

The disease, called Fire Blight, is caused by a bacterium, *Erwinia amylovora*. At present the disease appears to be confined to relatively few orchards, but it is causing serious damage to pear trees and many mature trees have been killed or severely damaged since 1957. No attacks have so far been discovered in apple orchards. There is, however, no reason to suppose that the disease will be confined to pears. Most of the outbreaks are on the variety Laxton's Superb, but other varieties, including Conference, are affected.

In North America Fire Blight has existed for many years and has been largely responsible for the decline in pear growing in eastern U.S.A. and for the gradual elimination of the more susceptible varieties of apples. Under suitable conditions good orchards can be virtually ruined overnight. Control of the disease has proved very difficult there and no spray programme has been more than moderately successful.

At this time of the year diseased trees will either be dead or one or more branches will have died. Brown or blackened leaves and fruit attached to the tree will remain attached after the healthy leaves have fallen. Next spring the disease will become active again and spread along some of the branches. These active diseased areas will ooze bacteria in wet weather and the bacteria will be spread by insects and rain to blossoms. The blossoms become blackened and die and the disease invades the tree through the fruiting spurs. Pollinating insects, particularly honey bees, will carry the disease from diseased to healthy blossoms and thus from diseased to healthy trees.

Growers are strongly advised to consult local officers of the National Agricultural Advisory Service immediately if they suspect that the disease is present on their trees.

New recommendation for controlling Rhizoctonia infection in the soil and preventing Botrytis on lettuce grown under cold glass, has been announced by Bayer Agriculture Ltd. This is an additional use for "Botrilex," now that extensive trials work has been successfully completed.

"Botrilex" may also be used as a bulb fungicide for controlling Tulip Fire and other diseases of bulbs.

Beetles are causing much concern at St. James's Church, Warrington. Due to the activities of the furniture beetle at least 200 chairs will have to be scrapped.

Export value of pesticides from the U.S.A. for 1957 was 85 million dollars, compared with 77 million dollars two years previously.

After five years in Upper Brook Street the London head offices of Midland Silicones Ltd., opened in new and more spacious premises in Knightsbridge on Monday, 13th October.

The move has been dictated by the steadily increasing volume of business now being handled by the company—a member of the Albright & Wilson Group and a U.K. associate of the American Dow Corning Corporation.

NEW PRODUCTS

Standardised Disinfectants Company Limited of 23 Sloane Street, London, S.W.1, have just produced a new livestock dip known as Zondagam Extra.

This dip is a highly concentrated cattle dip or spray especially produced to make dipping less costly particularly in those countries where transportation is difficult and expensive.

The dip is effective against all species of ticks (except BHC resistant varieties) and against other external parasites of animals.

It is especially formulated for treating livestock and is completely safe to use on all animals; cattle, horses, sheep, goats and pigs.

An advantage is that Zondagam Extra may be mixed with all types of water—hard, soft or brackish—and it contains carefully selected germicides. An indication of the powerful germicidal nature of this dip may be gathered from its high Rideal Walker Co-efficient of—15.

Especially formulated for dipping and spraying livestock, Zondagam Extra may be used, too, for control of flies by spraying farm buildings, byres, piggeries etc., but it is a veterinary insecticide and must not be used for agricultural pest control.

Cooper, Pegler and Co., Ltd., of Burgess Hill, Sussex, have produced the " Mapic 44 " Soil Injector, a machine specially designed for the application of fertiliser solutions underground to the roots of fruit trees, bushes etc.

Another is the " Mapic D2T " Soil Injector, designed for injecting disinfectants, insecticides, fungicides etc. under high pressure into the soil.

The same Company has just introduced a Knapsack Container, holding two-gallons, for use with their " Hydra " Sprayer.

The Dorman Sprayer Co., Ltd., of Ditton Walk, Cambridge, has developed the Dorman ultra-low pressure spraying system with the main object of eliminating wind drift which causes damage to susceptible crops adjoining those under treatment.

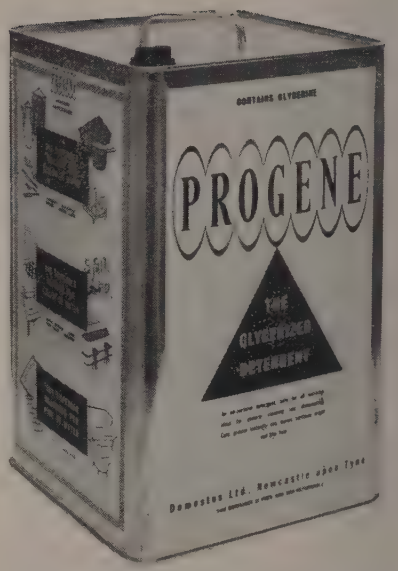
Using the conventional type of sprayer with flat fan nozzles operating at from 30 to 40 lbs. p.s.i. pressure, the spray is produced by impacting a stream of liquid under high pressure through a restricting orifice. With the very sudden drop of pressure which occurs at the nozzle orifice, an unavoidable production of droplets of greatly differing sizes and weight results. The smaller droplets are drift-prone and under conditions of even a light wind will give rise to drift which can cause serious damage to neighbouring susceptible crops.

The new nozzle, which produces the spray in the form of a hollow cone, has been designed to operate at very low pressures, and for the low volume rates normally employed the recommended operating pressure is 10-15 lbs. p.s.i.

A rotary motion is imparted to the liquid in the nozzle chamber which produces a centrifugal force to the liquid, breaking it up into fine droplets on leaving the nozzle orifice. A feature of the new nozzle is that at no point is there a sudden drop in pressure and the reduction of pressure occurs within the nozzle so that any fine droplets are re-absorbed before leaving the orifice. This has resulted in the production of a high degree of uniformity of droplet size and the almost entire elimination of the small, drift-prone droplets.

KWH, Bommelseweg 43-44, Wadenoyen, Holland, have produced shoulder-mounted machines for use in close plantations and positions generally regarded as inaccessible.

London representatives are Kiekens Whirlwind (London) Ltd.



Domestos Limited of College Works, Albion Row, Newcastle-upon-Tyne, 6, have now produced a new industrial product, "Progene," which is a liquid detergent containing glycerine for extra protection to the hands.

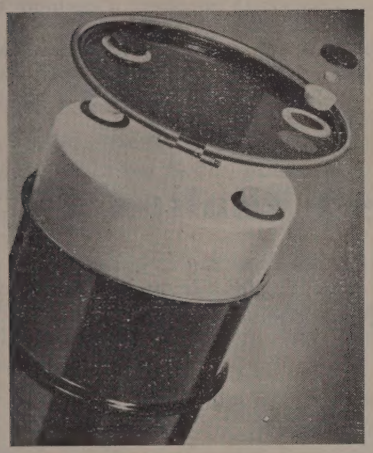
The picture shows a four gallon, non-returnable can with Dispenser measure. This measure is a standard fitting.

Deosan Limited announce the replacement of their well known Machine Dishwashing Detergents H.D.1 (hardwater) and H.D.2. (soft. water) with a newly formulated powder. This will be known as Deosan D.M.D.

Two new products are announced from C. F. Gerhardt Ltd., after four years of intensive research with the sense of taste in poultry, "Thram" has been formulated as an anti-pecking spray for the elimination of feather-pecking and cannibalism. "Thram" is not an insecticide and is effective because of its outstandingly offensive taste to poultry.

" Wormex " is the name of an entirely new worm powder for pigs, poultry and horses. It is based on piperazine. An advantage of "Wormex" is that there are no side-effects and no losses of weight recorded.

New Products



The "Valethene" drum

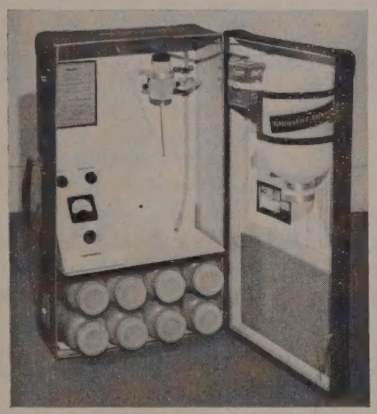
Metal Containers Limited, 17 Waterloo Place, Pall Mall, London, S.W.1.—who are one of the world-wide Van Leer Group of Companies—have made an outstanding contribution to the packaging of chemicals.

This new container, manufactured exclusively by Metal Containers Ltd., combines all the accepted advantages of steel, i.e. strength, endurance and safe handling, with the high chemical resistance and inert properties of polyethylene.

The feature of the " Valethene " drum is the semi-rigid polyethylene inner container, " a drum within a drum " which fits snugly in the steel outer container. Two moulded-in necks in the head of the inner container fit through the lid of the steel outer container.

Resilient rubber washers fitted to the necks between the inner and outer containers prevent seepage of liquid between these parts.

The lid is fully removable, allowing the inner lining to be removed for inspection or replacement. It has a rubber sealing washer and is fastened with a bolt type closing ring. Polyethylene bungs and washers with heavy buttress threads screw into the necks. These incorporate an inner thread into which a $\frac{3}{4}$" BSP Tri-Sure polyethylene bung and washer is fitted. This provides a vent for emptying and takes the special polyethylene taps also available. Tinplate screw-caps and wads complete the closures. The drum is finished black externally, the inside being coated with special acid-resisting paint. Weight of the drum is approximately 62 lbs.



Elgastat Field Research Unit

Elga Products Ltd., of Railway Place, London, S.W.19, Ion Exchange specialists, have just produced the Elgastat Field Research Unit, designed specifically to provide dionised water instantly from lake, river or well water. As the illustration shows it is used in a tropicalised carrying case, total weight, 25 lb., and costs only £45.

The unit is supplied complete with sufficient ion exchange cartridges to provide a minimum of 800 litres of elgalised water.

Many of this company's units are used by pest research laboratories particularly for feeding humidifiers and conditioning plant with solid free water. In this way no defurring of the plant is essential. The research laboratory of Pest Infestation at Slough uses several of the firm's units.

The Power Flexible Tubing Company Limited, of Derby Works, Vale Road, London, N.4, are producing interlocked hose in galvanised steel or bronze up to 12" bore, and suitable for conveying fluids at reasonably high pressures and temperatures. It is usually used for static bends where there is not a great deal of movement.

For conditions involving continuous movement or where searching fluids are being used, steel or bronze " Metalflex " tubing is more suitable, and it is supplied in two grades, one being 50% more flexible than the other.

DATES FOR THE DIARY

(*Hon. Secretaries are invited to send in details for inclusion in this column*).

3rd-6th November.
British Weed Control Conference, 1958. Organised jointly by the Society of Chemical Industry and the British Weed Control Council, Hotel Metropole, Brighton, Sussex.

3rd-7th November.
The Sports Turf Research Institute, Bingley, Yorkshire. Course of Instruction, greenkeepers and groundsmen.

6th-9th November.
Scientific Instrument Manufacturers' Association of Great Britain, Convention, Majestic Hotel, Harrogate, Yorkshire.

7th November.
Association of Applied Biologists: General Meeting followed by a Symposium on Clubroot Disease. Lecture Hall, British Museum (Natural History), Cromwell Road, London, S.W.7.

10th-15th November.
Public Works and Municipal Services Congress and Exhibition, 1958, at Olympia, London.

5th December.
Society of Chemical Industry: (Pesticides Group) (Jointly with Agriculture and Fine Chemicals Groups) 14 Belgrave Square, London, S.W.1. Dr. P. W. Brian " The effects of gibberellic acid on plant growth and developments" and Dr. B. E. Cross, " The chemistry of gibberellic acid."

BOOK REVIEW

Chambers's Technical Dictionary.

Edited by C. F. Tweney and L. E. C. Hughes, A.C.G.I., D.I.C., B.Sc., (Eng.), Ph.D., M.I.E.E., F.R.S.A.

Published by W. and R. Chambers, Ltd., 11 Thistle Street, Edinburgh, 2: 6 Dean Street, London, W.1. Price 35s. net.

This revised edition, as with previous revised editions, contains a Supplement which has been enlarged. The original text, too, has been revised.

Owing to the demise of the Principal Editor, Mr. C. F. Tweney, the main burden of this task has fallen to Dr. L. E. C. Hughes, the Associate Editor, who has added many new definitions in the field of Nuclear Physics, Electronics, Automation etc.

This new edition contains 55,000 entries drawn from more than 100 branches of scientific and industrial activity. In all there are 1,028 pages, including the Supplement, which runs to 74 pages.

In the preface, one reads the following:—

> *"What, it may be asked, is a technical term? It may be defined as a word or expression which has special significance and value to a person learned or dexterous in a branch of knowledge relating to some particular human activity or to some particular aspect of nature. A dictionary of technical terms, therefore, must aim at including, as far as its scope allows, all terms having such 'special significance and value.'"*

It is, therefore, somewhat surprising to find no mention in the dictionary proper or the Supplement of "pesticides" or "herbicides" although "fungicides" is included.

However it would be churlish to suggest that these omissions detract from the overall value of this work.

Pest technologists will find this a volume of immense importance and a source for constant reference.

NEW PUBLICATIONS

SIMA Bulletin, Vol. II, No. 4.

Published by Scientific Instrument Manufacturers' Association of Great Britain, 20 Queen Anne Street, London, W.1.

As the name implies, this is a Journal for the British Instrument Industry, but the foreword by the President of SIMA (Mr. R. Barrington Brock, M.B.E.), contains a comment of more than usual significance:

> *"As a scientist in my earlier jobs, I always felt that there was a terrible lack of liaison between the manufacturers and the users."*

It would be difficult to conceive of anything more appropriate for many sections of British industry at the present time

SIMA is to hold a Convention at Harrogate, November 6th-9th inclusive.

Unilever Films, Catalogue 1958-9.

Published by Unilever Limited, Blackfriars, London, E.C.4.

The films listed in the catalogue cover a wide range and include one, "Maximum Crop," the story of the growing and canning of harvest peas for Batchelors—pioneers in the development of the processed pea.

The film depicts the various stages in the cultivation of the crop, from the selection and testing of seed and its protection from disease to the preparation of the seed bed.

The latest methods of drilling, spraying, harvesting, and threshing the crop are shown, culminating with its factory arrival, canning, packing and despatch.

"Botrilex" Leaflet.

Published by Bayer Agriculture Ltd., Thorneycroft House, Smith Square, London, S.W.1.

The revised "Botrilex" leaflet, which gives new recommendations for controlling Rhizoctonia infection in the soil and preventing Botrytis on lettuce grown under cold glass.

Careers in Plastics. Third Edition.

Published by the Plastics Institute, 6 Mandeville Place, London, W.1.

An informative booklet telling the would-be-entrant to the Industry what it has to offer and what are his prospects.

Fourth Progress Survey with Report and Accounts of N.I.F.E.S.

Published by National Industrial Fuel Efficiency Service, 71 GrosvenorSt., London, W.1.

The National Industrial Fuel Efficiency Service is performing an extremely valuable service in pointing the way to economy with efficiency in fuel consumption for industry.

This progress survey is a mine of information and anyone interested should write to Dr. Angus Macfarlane, Chief Executive.

Chambon: Review of the House of Chambon. Volume Seven.

Published by Chambon Limited, Riverside Works, Standish Road, Hammersmith, London, W.6.

This survey deals with machines manufactured by the company for economy in packaging.

Sports Turf Bulletin, No. 43. October -December, 1958.

Issued by The Sports Turf Research Institute, St. Ives Research Station, Bingley, Yorkshire.

Pyrethrum Facts, 1958 Edition.

Issued on behalf of The Pyrethrum Board of Kenya, The Pyrethrum Board of Tanganyika and Socopa by Press and Public Relations Ltd., 47-48 Berners Street, London, W.1.

Relates facts about P.Y.R. African Pyrethrum.